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Experimental Analysis of Aggression.

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ABSTRACT

In 1982, Iwata, Dorsey, Slifer, Bauman, and Richman developed a systematic assessment method to identify the operant functions of self-injurious behavior. In this study, the Iwata et al., method was used to assess the operant functions of aggression displayed by children and adolescents with developmental disabilities. Although researchers have demonstrated that aggression serves operant functions, there has been no comprehensive analysis of aggression using the Iwata et al. method. Twelve children and adolescents participated. The experimental conditions from the Iwata et al. method were replicated (i.e., attention, instructional demand, play, no interaction); also, a tangible positive reinforcement condition was included in some cases.

Results for 11 of the 12 participants identified clear operant functions (positive or negative reinforcement) for aggression. For one child, subsequent analyses suggested that aggression was sensitive to peer attention. Results are discussed in terms of incorporating an operant model into more general discussions of aggression.

INTRODUCTION

Aggression

Aggressive behavior exhibited by persons with developmental disabilities can have serious social and educational repercussions. In behavior-analytic research, an assumption exists that aggression is an operant behavior sensitive to contingencies of reinforcement. Perhaps this assumption is based on the general use of functional analysis procedures to evaluate serious behavior problems (e.g., Iwata, Dorey, Slifer, Bauman, & Richman, 1982/1994). However, there has been no comprehensive and systematic replication of the Iwata et al., (1982/1994) study using aggression as the target behavior. Therefore, the primary purpose of this study was to extend and replicate functional analysis procedures described by Iwata et al., (1982/1994) to aggression. In an attempt to evaluate a systematic functional analysis protocol, the first 12 clients with developmental disabilities referred for assessment and/or treatment of aggressive behavior participated in the study.

There are several reasons for attempting to identify variables maintaining/supporting aggressive behavior. First, a significant number of individuals are referred for intensive behavioral treatment from administrators, physicians, parents, and mental health care providers, due to potential interference with ongoing educational, social, and vocational programming. To the extent that maintaining variables for aggression can be identified, intervention

packages can be implemented that may subsequently reduce aggression rates. For example, if an individual's assessment data indicate that aggression is sensitive to positive reinforcement (e.g., access to attention or tangible stimuli), specific appropriate requests for preferred stimuli can be reinforced while aggression is placed on extinction (Northup et al., 1991). Similarly, if an individual's assessment data indicate that problem behavior is sensitive to negative reinforcement (such as escape from instructions), compliance to instructions could be reinforced while aggressive behavior is placed on extinction (Marcus & Vollmer, 1995). Thus, there is a clinical need to analyze and test aggressive behaviors.

Second, aside from the potential clinical utility of understanding aggression, there are conceptual reasons for investigating aggression. For example, there are several hypothesized etiologies of aggressive behavior including the respondent hypothesis, the social learning hypothesis, and the operant hypothesis (Bandura, 1977; Carr, 1977; & Hutchinson, 1973). It is possible that some portion of aggressive behavior is operant and by evaluating such mechanisms, some specific conditions maintaining aggression may be identified.

Third, the clinical and scientific goals of behavior analysis are interlocked. Once an operant function of aggression is identified for a given individual, that individual may participate in specific types of treatment

analyses that may have been irrelevant had the operant function not been identified. By analogy, in self-injurious behavior research, Iwata, Pace, Kalsher, Cowdery, and Cataldo (1990) conducted functional analyses of seven participants' self-injurious behavior (SIB). The results of the functional analyses showed that each of the participants SIB was sensitive to negative reinforcement. Therefore, for each of the participants, an escape-extinction procedure was implemented; it was the results of the functional analysis that identified the individuals as appropriate participants in the study. Similarly, if operant functions of aggression are reliably identified, specific intervention protocols could be evaluated. In summary, there are clinical, conceptual and experimental reasons for conducting functional analyses of aggressive behavior. Prior to discussing potential maintaining variables of aggression, a review of potential etiologies for aggression will be presented.

Literature Review

Aggressive behavior is one of the primary reasons that persons with developmental disabilities are referred for treatment (Baum, 1989; Matson & Gorman-Smith, 1986; Schroedar, 1991). Aggressive behavior includes violent behaviors in which an individual attempts to physically harm another person (e.g., kicking, hitting, spitting, pinching, pulling others hair)(Northup et al., 1991). Broader definitions of aggressive behavior may include verbally

inappropriate behavior (e.g., cursing, name calling, threatening) and property destruction (breaking items, throwing items, or both)(National Institutes of Health, 1991). Aggressive behavior is particularly disconcerting because it often results in physical harm to others, which can lead to the removal of the aggressor from educational, residential, and vocational settings. Specifically, individuals who exhibit aggressive behavior are at risk for special education, suspension and expulsion from the school setting, removal from the home environment, rejection from peers, jail, hospitalization, and institutionalization (Wehby, Dodge, & Valente, 1993). Further, aggressive behavior has been identified as the most common and frequent reason for administration of psychotropic medications (Mulick, Hammer & Dura, 1991).

Hill and Bruininks (1984) suggested that the cost of care for an individual with developmental disabilities who exhibits aggressive behavior may be significantly higher then the cost of care for persons with developmental disabilities who are nonaggressive. Specifically, aggressive behavior often results in more restrictive placements and higher staff turnover within residential and vocational placements and many community-based residential facilities (e.g., group homes) will not accept individuals with developmental disabilities who exhibit aggression (Northup et al., 1991). Individuals who exhibit aggressive behavior are therefore at risk for permanent

institutionalization. Braddock (1986) estimated that in 1986, the United States spent at least $3 billion on patient care for individuals with developmental disabilities who frequently engaged in destructive behaviors.

Prevalence

The prevalence of persons with developmental disabilities who exhibit aggressive behavior is unclear. The Department of Health and Human Services estimated that the prevalence of persons with developmental disabilities who exhibit aggressive behavior includes at least 26,200 institutionalized patients as well as another 55,100 noninstitutionalized persons (National Institutes of Health, 1991). These numbers are based on population estimates of 137,000 institutionalized and 900,000 noninstitutionalized mentally retarded children and 1 million noninstitutionalized mentally retarded adults. However, Eyman and Call (1977) and Griffen et al., (1990), estimated the prevalence of aggression in persons with developmental disabilities to be between 28-31% of the population. Sigafoos, Elkins, Kerr, and Attwood (1994) conducted a survey in Queensland, Australia which estimated the prevalence of persons with developmental disabilities who exhibit aggressive behavior as approximately 35% of persons living in institutions, 17% of persons living in group homes, and 3% of persons who live at home or have other living arrangements. The study showed the overall prevalence of aggression to be 11% of the persons with

developmental disabilities surveyed. Specifically, 271 individuals out of 2414 surveyed were identified as aggressive.

Epidemiological data on aggression in developmental disabilities cannot be assumed to reflect the prevalence of the phenomenon accurately, because definitional problems abound. For example, at the most basic level, virtually everyone is aggressive to some extent. Therefore, the prevalence of aggressive behavior is somewhat subjective, because no objective criteria have been established within the literature pertaining to the prevalence of aggressive behavior. It appears that some baseline rate or intensity of aggressive behavior is considered "normal." However, typical age appropriate norms of aggressive behavior both within the entire population and persons who have a developmental disability are unclear. It is therefore possible that referral for assessment and/or treatment of aggressive behavior may be idiosyncratic across populations, topographies, and settings.

Etiology of aggression

There are several hypothesized etiologies of and maintaining variables for aggressive behavior. Examples include: (a) the catharsis hypothesis; (b) the biological predisposition hypotheses (c) the respondent hypothesis; (d) the predictability hypothesis; (e) the social learning hypothesis; and (f) operant hypotheses.

Catharsis hypothesis

Those who support the catharsis hypothesis suggests that aggression allows the aggressor to "purge" himself or herself of hostile anger towards the victim. That is, the aggressor is frustrated and angry with the victim and this feeling of frustration results in an arousal response that motivates the aggressor to emit the aggressive response. Likewise, the "purge" of the frustration results in a decreased rate of overall aggression (Myers, 1993).

Geen, Stonner, and Shope (1975) attempted to evaluate the catharsis hypothesis by exposing 3 groups of 30 participants (N=90) to learning trials (i.e., stating personal position regarding a controversial issue, maze learning, translating alphabetical code) of a confederate, posing as a participant. After a confederate produced an error during the initial learning trial (i.e., stating a personal position), one group of participants was asked to administer shock to the confederate, another group of participants observed the experimenter shock the confederate, and the third group of participants waited (no shock was administered). Next, each of the 3 groups were asked to complete a subsequent learning trial and each group of participants was asked to administer shock to the confederate following errors. Further, the participants were asked to systematically increase the intensity of the shock as the number of errors increased. Dependent variables included shock intensity, blood pressure, and

results from a self-report questionnaire provided to the participants at the end of the study. Results showed: a) reduced blood pressure following aggression (after shocking the participant) which is referred to as "physiological catharsis"; and b) the group of participants who experienced reduced blood pressure following aggression (i.e., those participants who shocked the confederate during the initial learning trial) also significantly increased the intensity of shock to the confederate during subsequent learning trials. Thus, Geen et al., (1975) demonstrated that rates of aggression did not significantly reduce after an aggressor was allowed to assault a victim. Further, the results suggested that aggression may have actually increased after the aggressor was permitted to assault the victim.

Although other similar attempts have been made to evaluate the catharsis hypothesis, at present, there is no consensus on how to operationalize constructs such as frustration, purging, and hostility. Thus, experimental analysis of the catharsis hypothesis remains all but impossible, and the utility of this hypothesis in understanding the motivation of aggression is extremely limited (Carr, 1977).

Biological predisposition hypothesis

The biological predisposition hypothesis suggests that aggressive behavior is typically exhibited by a subset of persons with developmental disabilities who have a comorbid diagnosis with a continuum of antisocial behavior (i.e., opposition defiant disorder [ODD], conduct disorder [CD], antisocial personality disorder). Several review papers note that persons with aggressive behaviors and comorbid antisocial behaviors will typically follow a developmental course, often beginning during early childhood and progressing throughout adulthood. This course usually begins with a diagnosis of ODD which then leads to CD and finally progresses to antisocial personality disorder (Kazdin, 1987; Patterson, 1993; and Wehby, et al., 1993).

Specifically, ODD is defined as a reoccurring pattern of interchangeable, inappropriate behaviors such as noncompliance, persistent testing of limits, arguing, loss of temper, and/or engaging in annoying behaviors (Baum, 1989). CD is defined as "a repetitive and persistent pattern of behavior in which the basic rights of others or major age-appropriate societal norms or rules are violated" (American Psychiatric Association, 1994, p. 85). Individuals who exhibit conduct disorder typically exhibit noncompliance with adults, lying, cheating, theft, academic difficulties, truancy, fire setting, vandalism, cruelty to animals, property damage, forcing sexual activity and/or drug abuse (Baum, 1989; Dumas, 1992). Similarly, antisocial

personality is defined as "a pervasive pattern for, and violation of, the rights of others that begins in childhood or early adolescence and continues into adulthood" (American Psychiatric Association, 1994, p. 645).

The current literature concerning CD suggests there is an underlying genetic predisposition as well as an antisocial trait that remains stable over the developmental course of an individual's life (Kazdin, 1987; Patterson, 1993). The body of literature surrounding the notion of biological predisposition and underlying antisocial trait includes evidence and risk factors that range from physiological abnormalities to extra familial difficulties. Physiological links have included minor physical abnormalities (e.g., wide gap between first and second toe, curved fifth finger) and increased prevalence of seizures. Further, early temperament problems may be traced back to the neonate (e.g., irregularity in wake/sleep cycle and eating patterns, difficulty adapting to novel stimuli, increased negative emotional reactions) have been correlated to later aggressive and antisocial behaviors (Dumas, 1992; Lytton, 1990). Additional evidence of the biological disposition includes a cluster of symptomatology used as a construct for identifying individuals with ODD, CD and antisocial behavior (e.g., high incidence of families with maternal depression, marital distress, disturbances in the parent-child relationships, and/or deficits in parenting

skills) (Forehand, 1986; Gluck & Sackett, 1974; Lytton, 1990; Kazdin, 1987; Patterson, 1993).

Despite some preliminary evidence, empirical data supporting antisocial traits and biological predisposition for some individuals who exhibit aggression while others do not are inconclusive. The majority of studies incorporate correctional risk factors and hypothetical constructs that are difficult to operationalize. Additionally, to a degree the biological predisposition hypothesis relies on circular logic. That is, individuals with ODD, CD, or anti-social personality disorder exhibit aggression while aggression is a definitional component of ODD, CD, or anti-social personality disorder. Therefore, when a diagnosis of CD or a similar disorder can be made, the direct link to specific maintaining variables or individualized intervention strategies is unclear.

Thus, the biological predisposition theory suggests that genetic, physiological, and other constitutional factors contribute to antisocial aggression (Plomin, Nitz, & Rowe, 1990). The child's temperament, hormones, and physique interplay with environmental factors such as natural reinforcers and aggressive models (Perry, Perry, & Boldizar, 1990). For example, a child with an irritating, difficult temperament is more likely to elicit the rejecting, punitive parental reactions that are conducive to aggressive development.

Basic behavioral genetic research seeks to determine the genetic and experiential differences in children who exhibit aggressive behavior (Plomin et al., 1990). Therefore, this research requires multivariate measures that differentiate types and levels of aggressive behavior, multimethod approaches that consider and compare interviews, questionnaires, self-report, parental, teacher, and peer ratings, and basic behavioral genetic designs (e.g., twin, family, and adoption studies).

However, there are very few behavioral genetic studies of antisocial behavior (Plomin et al., 1990). Family studies have indicated familial factors relevant to the development of antisocial personality are similar for males and females (Eron & Huesmann, 1990). As males are diagnosed about four times more frequently than are females, these results suggest females, for some reason, have a higher threshold for displaying the disorder (Cloninger, Christiansen, Reich, & Gottesman, 1978).

Two adoption studies suggest familial resemblance for antisocial personality have a strong hereditary component. Cadoret (1978) compared 18 adopted-away offspring of biological parents diagnosed as antisocial with a matched control group of adoptees with biological parents who had no antisocial diagnosis. Four children (22%) in the experimental group were diagnosed as antisocial while no adoptees were diagnosed as antisocial in the control group. Similarly, Jay and Stewart (1985) conducted a small adoption

study of aggressive conduct disorder in children (average age 11 years) as related to antisocial personality in parents. The study included 37 adopted and 42 nonadopted children diagnosed with aggressive conduct disorder. Eleven (30%) of the biological fathers of the adoptees, eleven (30%) of the biological mothers of the adoptees, and 14 (33%) of the biological fathers of the nonadopted children were diagnosed with antisocial personality. None of the adoptive parents were diagnosed with antisocial personality disorder. These results suggested (a) significant genetic links between aggressive disorder in childhood and adult antisocial personality, and (b) environmental transmission between parent and child may not be necessary for the development of aggressive conduct disorder (Jay & Stewart, 1985).

Respondent hypothesis

The respondent hypothesis suggests that some aggressive responses to specific environmental stimuli are innate or are conditioned via Pavlovian mechanisms. Stimuli demonstrated to elicit aggression include: (a) intense, painful stimuli (Hutchinson, 1973); (b) feared situations or stimuli paired with feared situations (Patterson, 1967); and (c) a territorial intrusion (Paluck & Esser, 1971). Hutchinson (1973, 1983) demonstrated that a variety of species (e.g., rats, monkeys, humans) do not adapt to some aggressive-eliciting stimuli. Specifically, noxious stimuli (e.g., shock, intense heat, loud noise) will elicit

aggressive-attack behaviors (e.g., biting) in some species even after repetitive exposure. Further, a variety of species will exhibit elicited aggressive-attack behaviors towards animate or inanimate objects (Ulrich & Azrin, 1962; Ulrich, Hutchinson, & Azrin, 1965). A relationship between the intensity of the aggressive-attack behavior and the noxious stimuli has been demonstrated empirically: the more intense the stimuli, the more intense the aggressive-attack, flight or fight behavior (Azrin, Hutchinson, & Hake, 1966; Hutchinson, Azrin, & Hunt, 1968; Pitts & Malagodi, 1966).

Additional support for the respondent hypothesis includes demonstrations of aggression as schedule-induced adjunctive behavior. Schedule-induced adjunctive behavior can be defined as behavior that occurs as a result of a reinforcement contingency but is not directly involved in or sensitive to the reinforcement contingency (Wetherington, 1982). Examples of schedule-induced adjunctive behavior include induced aggression, induced chewing, and induced drinking. In a review paper, Hutchinson (1977) referred to several empirical investigations that had demonstrated aggressive responses may occur as a by-product of independently operating contingency schedules. (Azrin, Hutchinson, & Hank, 1966; Hutchinson, Azrin, & Hunt, 1968). Although the aggression may appear to be occurring as a function of a specific schedule (e.g., potentially maintained by access to food), the reinforcement delivery is actually on a response-independent schedule (i.e.,

programmed consequences are not being provided for the aggression). Aggression as a schedule-induced phenomenon, persists even after repetitive episodes of aggression resulting in no programmed consequences. That is, the behavior does not extinguish (Staddon, 1977; Wehby, Symons, & Shores, 1995) and this distinguishes aggression maintained by operant contingencies from scheduled-induced aggression. Below are some additional examples of empirical studies which support the respondent hypothesis.

Azrin, Hutchinson, and Hake, (1966), Hutchinson, Azrin, and Hunt, (1968), and Pitts and Malagodi (1966) demonstrated elicited aggression in pigeons or squirrel monkeys by changing the schedule of food delivery from a continuous to an intermittent schedule. Specifically, Azrin et al., (1966) alternated schedules of food reinforcement with extinction contingent on pigeon key pecking. Results showed that pigeons aggressed toward other pigeons and stuffed models of pigeons immediately following the onset of the extinction condition. Further, the duration of the aggressive attack was directly related to the magnitude and duration of prior reinforcement.

Similarly, Hutchinson et al., (1968) trained squirrel monkeys to press a response bar for food on a continuous reinforcement schedule. Following the initial response bar training, ratio requirements were progressively increased. The results illustrated schedule-induced aggression in squirrel monkeys following changes in schedules of

reinforcement. That is, after a transition from continuous reinforcement to higher ratio requirements of responding, biting was elicited and increased. Pitts and Malagodi (1996) demonstrated the number of scheduled-induced attacks elicited was a function of the amount of food provided as reinforcement. That is, opportunity for larger quantities of food resulted in a higher number of attacks.

Thus, numerous studies have demonstrated the phenomenon of elicited aggressive-attack behaviors. However, embedded within the respondent literature, researchers suggest that aggressive behaviors also may be related to and influenced by the consequences the behavior produces (Mulick et al., 1991). For example, the respondent hypothesis does not appear to account for aggression that occurs in the absence of feared or noxious stimuli. Therefore, it may be important to evaluate other potential factors responsible for the occurrence of aggressive behavior.

Predictability hypothesis

Wahler, Williams, and Cerezo (1990) suggest that children engage in aggressive and coercive behaviors reinforced by "predictable" consequences from their parent. Specifically, the predictability hypothesis assumes that the parent typically responds to the child with indiscriminate, inconsistent, and chaotic sequential responses that may randomly range from positive, negative, or neutral. Further, the parents' responses appear to be independent of the child's behavior (Dumas, 1992; Wahler et al., 1990).

However, when the child engages in aggressive and/or coercive behaviors, parental response is notably more consistent (Wahler & Dumas, 1986). This consistency may negatively reinforce the aggressive behavior by allowing the child to "escape" from the inconsistent environment. Wahler et al., (1990) evaluated maternal responses before and after episodes of child aggressive and coercive behaviors. The results of the study suggested an increased probability of inconsistent maternal behavior immediately prior to a child emitting an aggressive behavior, a coercive behavior, or both. Likewise, there was a decreased probability of inconsistent maternal behavior immediately after a child engaged in aggressive behavior, coercive behavior, or both.

Although some research has been conducted to evaluate the predictability hypothesis, studies have not included an experimental analysis of proposed maintaining variables. Further, Wahler et al., (1990) indicated that not only was the response after the coercive behavior consistent, but it also frequently included the termination of instructions. Thus, it is possible that escape and avoidance from instructions may have actually been an operative negative reinforcement contingency.

Social learning hypothesis

Social learning theory suggests behavior can be learned through observation. By watching a behavioral model (i.e., someone engaging in behavior) an observer can learn to replicate the behavior (Bandura, 1977). Modeling and

imitation can occur in both programmed and unprogrammed situations. For example, behavior can be observed while sitting in a park watching children play on the swings. After a period of observation, the observer may imitate the play behaviors. Similarly, modeled behavior can be programmed into the environment. For example, a parent could model towel folding for a child. After the child observes the towel folding, it is possible that he or she may imitate the behavior.

Learning aberrant behavior can also occur through observational learning. For example, Bandura, Ross, and Ross (1963) demonstrated that children were more likely to engage in aggressive behaviors toward a doll after observing an adult engage in aggressive acts toward the doll. Children in paired control groups who did not observe the aggressive behavior model were less likely to engage in aggressive acts toward the doll. Research has shown that observers are more likely to imitate a model when: (a) the model is similar to the observer. For example, the model is the same sex or has similar physical features as the observer (Bandura, 1977); (b) the model is prestigious. For example, the model is a movie star or the star quarterback on the winning pro football team (Bandura, 1977); and (c) the modeled behavior is within the observers range of competence. That is, the model is physically, intellectually, and socially capable of performing the behavior (Zimbardo, 1988). Additionally, in the event that

the modeled behavior results in a reinforcing consequence, the observer is more likely to engage in the modeled behavior; a phenomenon known as vicarious reinforcement (Bandura, et al., 1963). If a model engages in a punished behavior, the observer will be less likely to imitate the behavior (Zimbardo, 1988).

Despite the evidence supporting observational learning, Patterson, Littman, and Bricker (1967) suggest that it is unlikely that all individuals who observe aggression will exhibit aggression, and, similarly, that all nonaggressive individuals have never observed an aggressive model. Although modeling may play a role in the development and etiology of aggressive behavior, it is unlikely that the social learning theory alone can account for the maintenance and generalization of all aggressive behaviors. Research has shown that the likelihood of imitation is increased if imitation is reinforced as a response class (Baer et al., 1968; Stokes & Baer, 1977).

Operant mechanisms

Aggression may be maintained as a function of reinforcement contingencies (Northup et al., 1991). Carr (1977) and Iwata et al., (1982/1994), identified several reinforcement contingencies that can maintain inappropriate behaviors including: (a) socially mediated positive reinforcement; (b) socially mediated negative reinforcement; (c) automatic reinforcement; and (d) multiple reinforcement contingencies.

One possible operant mechanism supporting aggression is socially mediated positive reinforcement in the form of attention or access to preferred items or activities or both (Carr, 1977; Vollmer, Iwata, Zarcone, Smith, & Mazaleski, 1993a). Individuals who exhibit aberrant behavior such as self-injury and aggression often have limited access to reinforcing stimuli, such as attention or toys (Mazaleski, Iwata, Vollmer, Zarcone, & Smith, 1993). For example, due to limited verbal repertoires, individuals with severe handicaps may have decreased social interactions, and may not be able to effectively communicate stimulus preferences (e.g., requesting access to specific items or toys). Also, aggression can be very disruptive and physically unsafe for caregivers, peers, and others in the environment (Vollmer et al., 1993a), so individuals confronted with aggressive behavior may attempt to intervene by either providing attention or delivering materials to the person exhibiting the aberrant behavior. Although such attention may attenuate a particular bout of aggression, it may also increase the future probability of the behavior (Northup et al., 1991; Patterson, Littman, & Bricker, 1967).

A second possible operant mechanism supporting aggression is socially mediated negative reinforcement in the form of contingent escape from or avoidance of aversive stimuli in the environment (Carr, 1977). For example, if an individual exhibits aggression or other aberrant behaviors when receiving instructions, a caregiver may be inclined to

remove the demand in an effort "to calm the individual down." If demands are functionally aversive, the behavior may be inadvertently negatively reinforced (Iwata, et al., 1990).

A third possible operant mechanism supporting aggression is automatic reinforcement (Cowdery, Iwata, & Pace, 1990). There is evidence to suggest that aberrant behaviors (e.g., SIB) may be maintained by reinforcement produced independent of the social environment. For example, SIB could increase the production of endogenous opiates, which may positively reinforce the behavior (automatic positive reinforcement). Similarly, a pain attenuating behavior could be maintained by automatic negative reinforcement. For example, individuals with severe otitis media possibly bang their heads because it decreases the pain associated with the infection (Cataldo & Harris, 1982). Currently, there are no published empirical studies that have identified an automatic reinforcement function of aggression. However, if other operant mechanisms (e.g., social positive reinforcement, social negative reinforcement) maintain some aggression, it is possible that reinforcement independent of the social environment also may maintain aggression. For example, the sensory experience of smelling, touching and/or feeling blood or broken flesh, may be reinforcing. Likewise, the

operant reinforcement may be derived from feeling the physical substance (the other persons body) as it is aggressed upon.

Reinforcement mechanisms for aggression may involve some combination of positive, negative, and/or automatic reinforcement (i.e., multiple control) rather than any single source of reinforcement. For example, Northup et al., (1991) conducted a functional analysis of aggression for individuals with developmental disabilities who exhibited aggressive behavior. Results of the assessments indicated that for two of the three participants aggressive behavior was sensitive to multiple contingencies. One participant's aggressive behavior was identified as differentially sensitive to tangible positive reinforcement and negative reinforcement. A second participant's aggressive behavior was identified as differentially sensitive to social positive reinforcement in the form of adult attention and negative reinforcement.

Other operant research suggests that both antecedent and consequent events can influence the frequency of aberrant behavior (Carr, 1977; Carr & Durand, 1985; Iwata et al., 1982/1994). Antecedents may serve as discriminative stimuli or as establishing operations for aggressive behaviors (Michael, 1982; Smith, Iwata, Goh, & Shore, 1995). Specifically, a discriminative stimulus is a stimulus in the presence of which a response is likely to be reinforced. For example, a child's mother is a discriminative stimulus

for attention seeking aggression because there is a history of parental attention being provided contingent on aggression displayed in her presence. However, the aggressive behavior may not occur in the presence of the child's teacher because there is no history of reinforcement delivery (i.e., attention) following aggression.

Similarly, establishing operations may serve as antecedent events that play an integral role in maintaining aggression. An establishing operation is a change in the environmental state of an organism that alters the effectiveness of a reinforcer and simultaneously alters the frequency of a response followed by the reinforcer (Michael, 1982; O'Rielly, 1995). The hours of sleep obtained during the previous night, onset of a physical illness, and food deprivation, among others, may serve as an establishing operation. For example, if an individual was deprived of food (e.g., 72 hours), the individual may be more likely to engage in a behavior that results in food delivery (e.g., searching the kitchen) than an individual who had just completed a full meal. That is, food is established as a more potent reinforcer following food deprivations. Similarly, if an individual was deprived of a full night's sleep (e.g., less than 4 hours), the individual may be more likely to engage in a behavior that results in access to sleep (e.g., attempting to get into bed) or removal of aversive stimuli (e.g., escape and/or avoidance of instructions) than an individual who is well rested.

O'Rielly (1995) examined one participant's aggressive behaviors and found that when the participant was sleep deprived (obtained less than five hours of sleep during the previous night) rates of escape-maintained aggression were significantly increased. Thus, hours of sleep appeared to function as an establishing operation for aggressive behavior; sleep deprivation established escape as a more potent reinforcer.

Summary of hypothesis

Although there are several hypotheses regarding the etiology of and maintaining variables for aggression, operant models have received the most empirical support. The catharsis hypothesis fails to operationalize constructs such as frustration and anger; therefore, empirical evaluation is significantly limited. The biological predisposition hypothesis has been supported only by correlational evidence that fails to show a functional relationship between proposed and actual maintaining variables for aggressive behavior. The respondent hypothesis appears to account for a portion of aggressive behaviors to a degree, but only attempts to explain aggressive behaviors that occur immediately following noxious stimuli or as a by-product of reinforcement schedules; there is evidence to suggest that aggressive behavior often occurs in situations absent of noxious, painful stimuli. Further, few experimental analyses have been conducted with human participants. Although research

on the predictability hypothesis is correlational and vague, the hypothesis suggests that operant mechanisms (e.g., negative reinforcement) account for the maintenance of some aberrant behavior. The social learning hypothesis has received considerable empirical support, but the specific roles of positive and negative reinforcement have not been thoroughly evaluated. Behavior learned via observation of reinforcement is not precluded from an operant analysis. The operant hypothesis seems to account for the maintenance of at least some aggressive behaviors. The roles of positive, negative, and automatic reinforcement have been established as maintaining variables for other severe behavior problems (e.g., self-injury, noncompliance), and there are published functional analyses identifying operant functions of aggression. The next section of this paper will discuss techniques for assessing aggression.

Assessment of Aggression

In this section, the assessment of aggressive behavior will be reviewed.

Goals of assessment protocols

Aggressive behavior is often difficult to assess due to: (a) a lack of consensus related to the etiology of and maintaining variables for aggressive behavior (see previous discussion); (b) the variety of assessment purposes (diagnosis, classification, intervention selection); and (c) measurement limitations (e.g., relatively low frequency of occurrence).

The types of assessment procedures used are largely determined by the philosophical orientation of the professional as well as the purpose of the assessment procedure (e.g., classification, diagnosis, intervention selection) (Hawkins, Patterson, Schweid, & Bijou, 1966). Due to the lack of consensus between professionals, the techniques used to assess aggression vary. For example, a psychologist who purports aggression is an inborn trait may be more likely to assess aggression in terms of a nomothetic or medical perspective (e.g., Diagnostic Statistical Manual of Mental Disorders-Fourth Edition). Those who purport aggression is initiated and maintained by mechanisms accounted for by the predictability hypothesis may be likely to conduct descriptive analyses that involve observing and coding parent/child interactions. Likewise, health care professionals who purport that aggression results from imitation and exposure to aggressive models may forego a thorough assessment, but may make treatment recommendations that include decreasing access to aggressive models (e.g., limiting access to violent television shows). Those who purport operant functions are responsible for the learning and maintenance of aggressive behaviors may conduct a functional analysis.

Aside from the philosophical orientation of the evaluator, the clinical orientation of the evaluator also may influence the assessment selection (Salvia & Ysseldyke, 1981). That is, the purpose of the evaluation may range

from classification/diagnosis, to direct service delivery (e.g., development of specific intervention techniques) (Witt, Elliott, Kramer, & Gresham, 1994). For example, a professional who is interested in classification and diagnosis may be interested in providing the individual with an appropriate diagnostic label. The necessity for an individual to have a documented differential psychiatric or developmental diagnosis to enter specific public service delivery systems often drives the assessment process (Forness & Kavale, 1991). Specifically, health care (e.g., adolescent psychiatric inpatient care), educational (e.g., child specific aids for the classroom setting), vocational (e.g., job coach), and residential (e.g., in home support) monies are typically directly tied to specific diagnostic labels. Furthermore, individuals who have been diagnosed and classified may have access to services that are not available to individuals who do not have a documented, diagnosed disability. For example, suspension and expulsion requirements are differentially implemented across school-age children depending on eligibility for specific diagnoses (Honig v Doe, 1988; Prasse, 1990). Children with developmental disabilities cannot be suspended or expelled from school if the precipitating behavior is determined to be a manifestation of the disability (Fischer & Sorenson, 1991). Aggression is therefore evaluated differently for different children depending on the diagnostic label.

A professional who is interested in developing specific intervention strategies for decreasing aggressive behavior may not be as concerned with diagnosis and classification. On the contrary, these individuals may be primarily interested in determining potential maintaining variables of an aberrant behavior in an attempt to develop interventions (Vollmer, Marcus, Ringdahl, & Roane, 1995).

The assessment of aggression may take a variety of forms due to measurement constraints. For example, aggressive behavior may only occur once per month, but when it does occur it results in significant tissue damage (e.g., bruises, loss of hair, broken skin and/or bones) or other problems. It is possible, though, that low rates are indicative of care-providers resistance to subject the participant or others to problem provoking situations. Specifically, due to the negative reinforcement obtained by care-providers (i.e., decreased rates of aggression), aggression may appear to be a low rate behavior when in fact, the precursors to the behavior have been limited. For example, Carr, Taylor, and Robinson (1991) empirically evaluated the results of child effects on care-provider behavior. Twelve adults taught four pairs of children; one child in each pair exhibited problem behavior and the other child in each pair typically did not. The results suggested care-providers avoid presenting instructions to children who engage in aberrant behavior sensitive to negative reinforcement. Aggressive behaviors, then, possibly occur

at low rates, at times, because care-providers within an aggressor's environment have learned to adapt their behavior in an effort to avoid an aggressive episode. Thus, it is possible that aggression, or the threat of aggression, significantly alters the adaptive functioning of the aggressor and those in the aggressors environment--even when the aggression is not occurring.

Individual assessment of aggression

Northup et al., (1991) reported that the topography and function of aggressive behavior may be idiosyncratic across individuals, settings, or, times. That is, aggressive behavior displayed by one individual may be completely unrelated to aggressive behavior displayed by another individual in virtually identical setting or situation. Likewise, an individual who displays aggressive behavior both at home and in other settings (e.g., at school, in public situations), may display aggressive responses for different reasons in those various setting.

Wehby, Symons, and Shores, (1995) suggested lack of treatment effects (e.g., failure to significantly reduce rates of aggressive behavior) may be due to insufficient assessment of potential maintaining variables. Specifically, a literature review by Wehby et al., (1995) identified aggression as a defining characteristic of students classified as emotionally/behaviorally disordered (EBD). Professionals have attempted to intervene and reduce rates of aggression for children diagnosed as EBD, however,

interventions have had limited success. Thus, a review of the literature strongly suggests the need for individual assessment.

Two potentially useful assessment methods are functional assessment and functional analysis (Sturmey, 1994). The functional assessment approach includes a variety of nonexperiemental methods that attempt to identify potential functions of aberrant behavior. Most functional assessments include some form of interview, rating scales, checklists or questionnaires, or direct behavioral observation. The functional analysis approach also attempts to identify the functions of aggressive behavior but involves the experimental manipulation of potential maintaining variables.

One of the most frequently used descriptive protocols for assessing aggressive behaviors is the interview. Interviews range from structured interview-based consultations to unstructured, open-ended interview formats of varying lengths. The interview process may include obtaining a developmental history, an academic review, and family history of psychopathology. In addition, interviews often incorporate problem-oriented questions that focus on problem frequency, bout duration, potential antecedents and consequences, and others reactions to the problem behavior. An example of structured interview for assessing aggression is the Diagnostic Interview Schedule for Children (DISC) (Costello, Edelbrock, Dulcan, Kalas, & Klaric, 1984). The

DISC is a highly structured interview format that yields information pertaining to the presence, absence, severity, onset, and duration of symptoms (Sattler, 1988, p.459). The interview includes specific questions presented verbally to an identified care-provider and/or the aggressor by the therapist (e.g., "sometimes kids rush into things without thinking about what may happen. Do you do that? (if yes) Have you always been like that? (if yes) How long have you been doing that?").

Rating scales, checklists, and questionnaires are other frequently used techniques to assess aggressive behaviors. Such methods are considered economical and efficient (Witt et al., 1994). In addition, rating scales, checklists, and questionnaires often provide information about the individual of interest relative to a normative sample (Baum, 1989). Examples include the Child Behavior Checklist (CBCL) (Achenbach & Edelbrock, 1983) and the Motivation Assessment Scale (MAS) (Durand & Crimmins, 1988). The CBCL is a standardized, parent-completed, 118-item checklist: Questions on the checklist have a 3-point scale of problem behavior severity ranging from most to least severe. The scale takes approximately 30-40 minutes to administer and yields both an internalizing and externalizing profile of behavior deviance and social competency as compared to a normalized sample. The CBCL is considered to have adequate reliability and validity (Sattler, 1988). The MAS is a 16-item questionnaire with a 7-point scale ranging from never

to always; the scale is designed to identify the source of reinforcement for an individual's problem behavior. The scale takes approximately 5-10 minutes to administer and yields information across four subscales: attention, escape, tangibles, and sensory consequences. Although the scale is reportedly easy to administer, the factor structure, validity, and reliability of the scale have been questioned (Newton & Sturmey, 1991; Zarcone, Rodgers, Iwata, Rourke, & Dorsey, 1991).

Naturalistic behavioral observations are frequently conducted when assessing aggressive behaviors. Such observations can be a direct means of assessing frequency, duration, intensity, and topography of a problem behavior without manipulating the participant's environment. Coding systems have been developed to categorize behavioral observations. For example, Reid (1978) developed a standardized 29-category observational code for recording family interactions. Similarly, Dunn, Barker, and Wahler (1981) developed a 29-category coding system designed to sample exchanges between the child and the child's adult and peer associates. Although, these coding systems serve to track instances of aggression, they provide only a systematic descriptive analysis of what is occurring in the environment. That is, the information obtained from the coding systems can only be used to provide correlational information (e.g., conditional probabilities) between behaviors and potentially related antecedents and

consequences. While causal information can be speculated, but not assured, by analyzing descriptive coding information.

Descriptive information can yield hypotheses about behavior-environment relations supporting aggression. Hawkins et al., (1966), for example, repeatedly observed one parent-child dyad in a naturalistic home environment. The identified child was a 4-year-old boy with developmental disabilities who had been referred for assessment and treatment of tantrum behavior (aggression, SIB, vocal threats). Hawkins et al., (1966) identified vocal reprimands and distraction methods (i.e., presenting novel activities, toys) as a frequent consequence provided contingent on inappropriate behavior. Therefore, Hawkins et al., (1966) informally hypothesized that the child's inappropriate behavior was sensitive to maternal attention.

Patterson et al., (1967) coded the frequency of aggressive behaviors (e.g., bodily attacks, retaliation, defensive postures, invasion of territory) for thirty-six preschool children. All of the naturalistic observations occurred at the preschool during unstructured free play situations. Following data collection, Patterson et al. (1967) performed statistical analyses comparing target aggressive behaviors and probabilities of specific consequences (e.g., peer attention, teacher intervention, presentation of toys, passive victimization). The results of the study indicated that preschool children were more

likely to engage in aggressive behaviors towards peers when aggressive behaviors resulted in access to preferred toys or peers engaging in various defensive postures. As such, positive reinforcement in the form of attention as well as access to preferred reinforcers (e.g., access to toys) appeared to maintain aggressive behavior (although reinforcement effects were not empirically tested).

Both Hawkins et al., (1966) and Patterson et al., (1967) hypothesized operant mechanisms of aggressive behavior, but no systematic experimental analyses were conducted. As stated previously, a functional analysis involves experimental manipulations that provide information about the potential relationship between a behavior and its maintaining variables. For example, Iwata et al. (1982/1994) attempted to identify idiosyncratic behavioral functions in several individuals by observing SIB under analog conditions in which potential sources of reinforcement were presented contingent on SIB. The analog conditions included social disapproval; academic demand; no external stimulation; and unstructured play. In social disapproval, the therapist's attention was contingent on emission of the target response(s). This condition was arranged to identify whether a participant's target behavior was sensitive to socially mediated positive reinforcement. Under academic demand conditions, task demands were presented using a graduated, three-prompt procedure that was removed contingent on emission of the target response(s).

This condition was arranged to identify whether a participant's target behavior was sensitive to negative reinforcement. A third analog condition provided no external stimulation and no programmed consequences for SIB, and was arranged to identify whether a participant's target behavior was maintained independent of social contingencies. Finally, unstructured play conditions served as a control in which there were no programmed consequences for inappropriate behavior. Praise and brief physical contact were provided contingent on appropriate behavior and delivered on a 30-second schedule and a variety of toys were available noncontingently. Presentation of these analog conditions in a multi-element design format enabled the researchers to identify environmental conditions that yielded high or low rate SIB (i.e., functional relations). For example, if a participant exhibited high rates of SIB during demand conditions and low rates of SIB during all other conditions, the assessment indicated that the individual's SIB was sensitive to negative reinforcement. Similarly, if a participant exhibited high rates of SIB during attention conditions and low rates of SIB during all other conditions, the assessment indicated that the individual's SIB was sensitive to positive reinforcement.

The Iwata et al., (1982/1994) study provided a foundation for a functional analysis approach, but several researchers have offered extensions or variations of experimental analyses. For example, Carr and Durand (1985)

described an assessment procedure designed to identify antecedent variables that may have served as discriminative stimuli or establishing operations for a variety of disruptive behaviors displayed by four school-age children. Three assessment conditions were presented during which the amount of attention and task difficulty was systematically varied (easy 100, easy 33, difficult 100). In easy 100 (a control condition) easy tasks (those completed with 100% accuracy) were presented and the experimenter provided attention during 100% of the pre-established intervals. During easy 33, tasks correctly completed with 100% accuracy were presented by the experimenter and attention was provided during 33% of the intervals. This condition was designed to determine if the participant's behavior was sensitive to positive reinforcement (occasioned by the relatively low frequency of attention). During difficult 100 conditions (the third category), tasks completed correctly at chance levels (25% correct) were presented while attention was provided during 100% of the intervals. This condition served to identify whether the participant's behavior was sensitive to negative reinforcement (occasioned by the relatively high degree of task difficulty). The results of the study suggested that the behavior of two children was sensitive to negative reinforcement (occasioned by the relatively high degree of task difficulty); one child's behavior was sensitive to positive reinforcement (occasioned by the relatively low frequency of attention),

and the fourth child's behavior appeared to be controlled by both positive and negative reinforcement.

Despite the benefits of functional analyses in assessing potential maintaining variables of severe behaviors, such procedures are sometimes described as: (a) time consuming--often involving 40-60 assessment sessions; (b) cumbersome--conditions often are conducted over an extended time frame; and (c) complex--the procedure requires extensive experimenter/therapist training (Northup et al., 1991). As a result, functional analyses do not always present a viable assessment option for some practitioners, particularly school or clinical psychologists.

In an attempt to circumvent limitations associated with lengthy functional analysis assessments, Northup et al., (1991) developed a method to conduct functional analyses in a 90-minute outpatient session. The assessment procedure involved two parts. First, a rapid reversal multi-element design was conducted in which two to four analog assessment conditions (alone, tangible, escape, social attention) were presented. Second, contingency reversal treatment probes were conducted. That is, the condition that produced the highest rate of aggressive behavior was presented. However, reinforcement was presented for a target mand (e.g., signing "please") as opposed to aggression. The results of the study suggested brief functional analyses can be used to identify the functional properties of aberrant behavior and to identify appropriate alternative responses.

Carr, Newsom, and Binkoff (1980) conducted experimental analyses of aggression for two developmentally delayed children. A reversal design was conducted in which one condition contained instructions and another condition involved no instructions. The results demonstrated that antecedent stimuli such as instructions and instructional materials increased the rates of aggression; when instruction were terminated, aggressive behavior decreased significantly. Although the authors hypothesized that aggressive behavior functioned as an escape response, no programmed consequences were provided for aggressive behavior during assessment. Additionally, the experimenters did not evaluate other potential operant mechanisms (e.g., positive reinforcement).

Wacker et al., (1990) conducted a functional analysis of aggression with a 9-year-old mentally retarded boy who bit and slapped care-providers and peers. Test conditions included "no contingency" (i.e., the therapist maintained close proximity with Jim and provided no programmed consequences for his behavior), social attention, escape, and differential reinforcement of other behavior (DRO) (i.e., attention was provided contingent on the absence of aggression). Conditions were presented within a multi-element design. Results suggested the child's aggressive behavior was sensitive to negative reinforcement. Likewise, Northup et al., (1991), in their brief functional analysis study, evaluated operant mechanisms maintaining aggression

for three individuals. Results suggested that aggression may be multiply controlled: for two of the three participants high rates of aggression were observed during analog positive and negative reinforcement conditions. Thus, Wacker et al., (1990) and Northup et al., (1991) demonstrated that aggressive behavior was differentially sensitive to positive and/or negative reinforcement. Results of these studies strongly suggest there is an operant component to aggression. More research is needed to understand operant mechanisms as they relate to aggression.

The most comprehensive and most widely replicated functional analysis model is the one outlined by Iwata and colleagues (1982/1994). However, to date, there has been no comprehensive and systematic replication of the Iwata et al., (1982/1994) study using aggression as the target behavior.

Purpose

One purpose of this study was to evaluate the operant functions of aggression by replicating the functional analysis methods described by Iwata et al. (1982/1994) in the analysis of SIB. Although there have been several documented operant assessments of aggressive behavior that have utilized a functional analysis approach, there has been no explicit replication of the Iwata et al., (1982/1994) procedures. There are published case illustrations suggestive of operant components of aggressive behavior; however, it is possible the case examples that have been

published are idiosyncratic. In an attempt to evaluate a systematic functional analysis protocol, the first 12 individuals with developmental disabilities referred for assessment and/or treatment of aggressive behavior participated in this study.

The second purpose of this study was more conceptual. Although behavior analytic research has evaluated aggression according to hypothesized operant functions, aggression is not typically classified according to functional properties in the general field of psychology. For example, little mention was made of the operant functions of aggression in literature reviews or general psychology literature. For example, introductory psychology text books typically present aggressive behavior as a behavior that can be explained in terms of the catharsis, respondent, and social learning hypotheses with little, if any, mention of the potential operant mechanisms supporting aggressive behavior (Kantowitz, Roediger, & Elmes, 1991; Lahey, 1995; Myers, 1993; Roediger, Rushton, Capaldi, & Paris, 1987; Worchel & Shebilske, 1989; & Zimbardo, 1988). A systematic replication of Iwata et al., (1982/1994) may add to the growing empirical support for operant mechanisms underlying aggression.

The third purpose of this study was to extend the clinical utility of assessments for aggressive behavior. That is, if maintaining variables for aggressive behavior can be identified, intervention selection may be more

systematic and individually tailored for the client. For example, if a participant's aggressive behavior was sensitive to positive reinforcement and the reinforcer (i.e., attention, access to tangible items) was withheld contingent on aggression, the behavior should extinguish. Likewise, if a participant's aggression was sensitive to negative reinforcement, escape from instruction could be withheld contingent on aggression and delivered contingent on compliance, thus, extinguishing aggression and strengthening compliance. Identification of operant mechanisms may result in more clinically significant reductions of aggressive behavior. The clinical utility of functional analysis methods also provides a method for screening participants into specific research protocols.

GENERAL METHOD

Subjects and Setting

Table 1 presents the demographic information for twelve children with developmental disabilities who participated in the study. All attended public school or pre-school programs. Participants were the first 12 children who were referred by parents and/or teachers for assessment of severe and chronic aggression.

All sessions were conducted in a vacant room at the child's school, the Psychological Service Center (PSC) located at Louisiana State University, or the child's home. The contents of the room varied according to the assessment conditions. Depending on the participants' schedule, two to four sessions, lasting either 5 or 10 minutes, were conducted two to five times per week.

Consent and Precautionary Measures

Parents of the participants previously provided consent for their child's participation through mechanisms already in place for Dr. Timothy Vollmer's research on severe behavior disorders. The general procedures described in this study do not deviate from the specifications of the over-riding protocol. Approval for the Vollmer protocol was obtained from Louisiana State University's Human Rights Committee (HRC) and the East Baton Rouge Parish School District. Specifically, the protocol outlined a package of services, incorporated into a variety of research protocols, that included assessment and treatment for severe behavior

disorders. Each consenting care-provider agreed to their child's participation in the following research components: (a) a descriptive assessment including parent/teacher interview and direct observations in the home or school environment; (b) preference assessments to determine preferred items, activities, or persons; (c) an analog functional analysis; (d) treatment based on noncontingent reinforcement and differential reinforcement; (e) parent and teacher training; and (f) follow-up. The primary purpose of this study was to extend the Iwata et al. (1982/1994) functional analysis methodology to children who exhibited aggressive behavior. Therefore, this study only presents information from the preference assessments and functional analyses of participants who were referred for the assessment and treatment of aggression. However, each of the participants were included in studies that focused on treatment development, parent/teacher training, and/or treatment follow-up.

Due to the nature of the behavior, aggressive behavior frequently causes harm to the aggressor and others in the environment. Therefore, precautions were taken with each of the participants to reduce the likelihood of injury to the participant, care-providers, therapists, and observers. Obtaining HRC approval and care-provider consent was only the initial steps in ensuring safety to all persons involved with the assessment and treatment of aggressive behavior exhibited by the participants in this study.

During the initial interview with parents and teachers, the therapist explained the functional analysis analog conditions would place the participant in analog situations resulting in high rates of aggressive behavior. One-way mirrors and windows allowed care-providers to observe parts of sessions without disrupting on-going sessions. On a daily basis, the therapist provided a brief overview of sessions conducted, rates of aggressive behavior, and any unusual behaviors to the care-provider. In addition, all questions and concerns were addressed. Periodically, the therapist reviewed, in a written progress note, the participant's behavioral graphs and progress. Progress notes were sent to primary care-providers, teachers, and school administrators.

At least two experienced therapists were present during every assessment session. For participants who engaged in high intensity aggression, at least three therapists were present in case additional assistance would be required. All observers were seated either across the room from the participant or behind a one-way mirror. Protective equipment (e.g., long sleeve shirts, hair ties, padded arm guards, latex gloves) was available to therapists at all times, to be used at the discretion of the therapist.

For each of the participants, a "cut-off" criteria was established. That is, if the participant exhibited extremely intense aggressive behavior or if tissue damage occurred during the session, the session was immediately

terminated. In addition, the school nurse was contacted and the parent/legal guardian of the child was notified whenever injury occurred.

Prior to returning the child to the classroom or care-provider, a "cool down" period (e.g. 2-3 minutes) was established. That is, participants remained in the care of the therapist until the participant was calm and engaging in appropriate toy play. Participants were not returned to the classroom or care-provider during a tantrum or burst of aggression

Measurement

Aggression was defined as any hit, kick, bite, scratch, push, grab, object throw, spit, head butt, hair pull, or pinch directed at the therapist by the participant. The response was scored either when contact between the participant and therapist occurred or when the participant attempted to contact the therapist (as defined above). Tantrums were defined as screaming, crying, flopping to the ground, flailing arms and legs, throwing/overturning objects, running away from the assessment room, or aggression (see above description) (Sammy, Joe). Sammy and Joe's parents reported aberrant behavior occurred in a hierarchical response pattern initiated by tantrum behavior and subsequently resulting in aggressive behavior. The assessments for both Sammy and Joe were conducted by their parents while trained therapists' served as coaches. Due to parental discomfort, tantrums were identified as the primary

Table 1
Demographic Information

Name	Age (yrs)	Aggressive Behaviors	Assessment Setting	Other Behavior	Diagnosis	Medication	Current Functioning
Sammy	3	Hit, kick, bite; Tantrums (cry, flop to ground, throw objects)	Home	Pica	Speech delay, Articulation difficulty	None	Speech: Simple sentences, prints letters, counts to a hundred
Joel	5	Hit, kick, bite, scratch, push, grab, throw object at others	Home	Tantrums Repetitive twirling of objects	Autistic, Oppositional defiant disorder, *Mild	Ritalin (5 mg 3x per day)	Speech: 2-3 word phrases (spontaneous, echolic), operates Nintendo
Matt	4	Hit, scratch	Clinic	Tantrums	Chronic ear infections, Born with fluid in lungs	None	Speech: None, reaches for preferred items, eats with a spoon
Joe	4	Hit, kick; Tantrums (scream, cry, flop to ground, flailing arms/legs)	School	Active non-compliance	Language delay, Ear/sinus infections	Catapress (0.1 mg per day)	Speech: Complex sentences, reads simple books, tells time
Seth	6	Hit, kick, bite, spit, scratch, push, grab, head butt, pull hair, throw objects at others	Home	Tantrums Pica Enuresis Property damage	Autistic, Oppositional defiant disorder, *Moderate	None	Speech: 100 words, (spontaneous, echolic), follows simple instructions
Alvin	3	Hit, scratch, pinch, push, grab	School	Tantrums Non-compliance	*Moderate Speech delay, Articulation difficulty	None	Speech: Name objects, toilet trained
Ron	4	Hit, kick, pinch	School	Mild disruption	*Profound	None	Speech: None, reaches for preferred items,
Robert	5	Hit, kick, bite	School	Self-injury Disruption Non-compliance Inappropriate vocalizations	Autistic, Infantile seizures, Ear infections, History physical abuse	None	Speech: Complex sentences, toilet trained, played simple songs on the piano
Rick	4	Hit, kick, bite, scratch, pinch	School	Self-injury Tantrums Active non-compliance	Fragile-X Syndrome, *Moderate, Ear infections, Tubes in ears	None	Speech: Seven word approximations, follows simple instructions
Kyle	4	Hit, kick, bite, scratch	School	Active non-compliance	*Severe, Ear/sinus infections, History of restraint to chair during school	None	Speech: None, reaches for preferred items, partially use a spoon
Emily	13	Hit, pinch, grab	School	None	*Severe	None	Speech: 2-3 word phrases, toilet trained
Marty	4	Hit, kick, bite, scratch, pinch, push, spit	School	Disruptive	Downs Syndrome Enuresis, Significant hearing impairment (hearing aids)	None	Speech: 2-3 words, simple manual sign language, augmentative Touch Talker

*Indicates probable level of functioning.

dependent variable and aggression was included within the definition of tantrum. For all other children, only aggression was targeted in the assessment. Aggressive and tantrum behaviors were defined based on parent/teacher interview, and informal observation of the participant in the classroom or home setting. Therapist behaviors were recorded to ensure integrity of functional analysis procedures. For example, during tangible positive reinforcement conditions toy presentation was recorded to ensure that stimuli were presented contingent on the participants' target responses (analogously, provision of attention and escape were recorded). Demands were defined as the first verbal instruction provided during a three-prompt instructional sequence from the therapist directed towards the participant. Compliance was scored when the participant completed the instruction after the initial vocal or modeled prompt. Compliance was not scored if physical guidance was administered. In-seat was defined as the participant's bottom contacting the seat of a chair with feet facing forward during a 10-second interval. Tangible delivery was defined as the therapist providing the participant access to preferred items/toys during a 10-second interval. Attention was defined as the therapist providing the participant with a brief vocal reprimand or providing vocal praise and/or brief physical contact during a 10-second interval.

Data Collection and Reliability

Data were collected on hand-held computers (Assistant model A102) by trained observers seated in the corner of the room or behind a one-way observation window. A second observer simultaneously (but independently) recorded data with a primary observer to establish inter-observer agreement. Observers were required to complete the following training procedures: (a) observers were trained in vivo (graduate students explained the data collection procedure to the observers and role-played therapist/participant assessment and treatment sessions while observers collected data); (b) observers were required to collect data during two sessions with two separate clients, and needed to average at least a 90% agreement with previously trained observers.

In all cases, interobserver agreement was calculated by using a method of dividing the session into consecutive 10-second intervals. For frequency recording, the smaller number of observed responses was divided by the larger number of observed responses in each interval, and these values were averaged across the session. For partial-interval response recording, the number of agreements (occurred/did not occur during the interval) were divided by the total number of intervals, and these values were averaged across sessions. Frequency recording was used for all discrete behaviors (aggression, tangible and attention presentation, demands). Interval recording was used to

score behaviors that were less discrete and subsequently difficult to count as a single instance. Specifically, tantrums and time spent seated were scored as a percentage of total session intervals.

Interobserver agreement was assessed during 40.5% of all sessions (range, 14.3% to 92.9% for any given participant). Interobserver agreement exceeded 90.8% for all dependent variables for all participants. Table 2 presents interobserver agreement for each participant.

Table 2
Interobserver Agreement

Name	% of sessions assessed	Aggression Mean	Aggression Range
Sammy	14.3	*100	*100
Joel	22.2	98.3	(96.7-100)
Matt	45.5	90.8	(83.3-100)
Joe	14.3	*100	*100
Seth	20.0	100	100
Alvin	58.3	91.0	(53-100)
Ron	40.0	95.9	(94-97)
Robert	92.9	99.4	(96.7-100)
Rick	58.3	98.9	(95.8-100)
Kyle	41.7	97.2	(90.8-100)
Emily	71.4	99.5	(94.5-100)
Marty	22.2 (FA)	100	100
	25.0 (DA)	98.5	(94.4-100)

*Indicates agreement for tantrums

Stimulus Preference Assessment

Each participant was exposed to a choice preference assessment, free operant preference assessment, or both based on the procedures developed by Fisher et al. (1992) and Roane, Vollmer, Ringdahl, and Marcus (1996). The purpose of the preference assessment was to identify potential reinforcers that could be used during the functional analysis. For either procedure, ten stimuli for each participant were included in the assessment. Stimuli were selected either because they were reported by the child's teacher, parent, or both as potential reinforcers or

were stimuli participants had been routinely exposed to during daily activities. Prior to the preference assessment, all stimuli were presented briefly (45 seconds) to the participant.

"Choice" preference assessment

Two stimuli were presented concurrently, and the item the participant initially touched was made available to the participant for manipulation or consumption for 10-15 seconds. After the participant indicated a preference, the item not chosen was removed immediately. If no selection was made after 20 seconds, both stimuli were withdrawn. Each item was individually paired with each stimulus on the list one to three times; pairing of stimuli and left/right position was randomized to ensure they came in contact with the stimulus.

"Free-Operant" preference assessment

Ten stimuli were presented concurrently on the floor or on a table. Each item was equally spaced apart from all other items. At the beginning of a session, the participant was placed in the room facing the stimuli. The participant was free to interact with any of the items or none at all during the assessment and at no time during the assessment were items removed from the participant. All contact between the participant's hands/fingers with an item was scored using 10-second partial interval recording. Each session lasted 5 minutes, and participants were exposed to a minimum of 2 sessions.

Following data collection, the researchers constructed a list of preferred reinforcers in hierarchical order. For the choice assessments, the percentage of the participant's response to each stimulus was calculated. Two or three of the reinforcers chosen at least 70% per opportunity were considered for use in assessment. For the free-operant assessments, an index of preference was calculated by dividing each 5-minute session into thirty, 10-second intervals. The percentage of partial 10-second intervals in which the participant manipulated each stimulus was divided by the total number of intervals and multiplied by 100. Two or three stimuli with the largest index of preference were considered for use in assessment.

Table 3 presents the preferred items identified during either the choice or free-operant assessments for each of the participants. For participants who were exposed to the "choice" and "free-operant" assessment, identical items chosen during both assessments were included in subsequent functional analysis conditions. For participants who chose different items during the assessments, all of the items from both assessments were included in subsequent functional analysis conditions (i.e., play, tangible, attention).

Table 3
Preference Assessments

Name	Preference assessment	Identified items
Sammy	Free operant	Toy-Story toys
Joel	Free operant	Nintendo
		Gloves
Matt	Choice	Puzzle
	Free operant	Car
Joe	Free operant	Doll house
		Family figures
		Plastic food
Seth	Free operant	Toy airplane
		Bed
		Book
Alvin	Choice	Toy train
	Free operant	Paper/markers
Ron	Choice	Toy rubber rings
		Blocks
		Plastic shapes
Robert	Choice	Rubber bands
	Free operant	Keyboard
Rick	Choice	See-N-Say
		Social attention
		Toy fan
Kyle	Choice	Zoo toy
	Free operant	Colored paper
Emily	Choice	Magazines
	Free operant	
Marty	Choice	Toy airplane
	Free operant	Farm animals
		Etch-A-Scetch

Procedure

Each participant was exposed to four or five experimental conditions. The functional analysis was based on procedures described by Iwata et al., (1982) and the design was based on Vollmer et al., (1995). The general procedures are described below.

Negative reinforcement (escape from instructional demands)

The experimenter presented the participant with instructions on a fixed-time (FT) 30-second schedule. Instructional tasks were similar to those presented in the child's educational environment, such as stacking blocks, working puzzles, pointing to body parts, sitting on a chair, and walking across the room. A graduated, three-prompt sequence was used to present instructions (Horner & Keilitz, 1975; Tucker & Berry, 1980). The three-prompt sequence consisted of: (a) the experimenter verbally requesting the participant to perform a task; (b) after five seconds of

noncompliance, the experimenter modeled compliance with the instruction; and (c) after five more seconds of noncompliance, the experimenter physically guided the participant (hand over hand) to comply with the instruction. Praise was delivered contingent on correct responding except following physical guidance. If the target aberrant behavior occurred, the instructional trial was terminated. For Joe and Rick, a negative reinforcement in-seat condition was included. During this condition, following aggression the instruction trial was terminated and the participant was permitted to leave the chair until the next scheduled instruction (instructions were scheduled once per 30 seconds). All attempts to leave the instructional context (e.g., table to chair) were blocked when the participant did not exhibit a aggression (or tantrum, for Sammy and Joe). The purpose of this condition was to test for behavioral sensitivity to escape as a reinforcing consequence (Carr et al., 1980)

Positive reinforcement (tangible)

This condition was included in the functional analysis for participants who reportedly became aggressive upon stimulus withdrawal or when access to preferred stimuli was blocked (Patterson et al., 1967). The experimenter presented stimuli to the participant prior to the beginning of the session. Once the session began, items were removed from reach but remained visible and were made available to the participant contingent upon a target response and remained

available for about 20 seconds. Tangible stimuli were selected on the basis of being "preferred" in the stimulus preference assessment, and because parents and teachers reported the items were correlated with problem behavior. The purpose of this condition was to assess whether the participant's target behavior was sensitive to positive reinforcement in the form of tangible stimuli (Patterson et al., 1967).

Positive reinforcement (attention)

The experimenter did not attend to the participant except to deliver reprimands, statements of concern, or both (for about 20 seconds) contingent on a target response. Preferred stimuli were made available continuously. The purpose of this condition was to identify whether the participant's target behavior was sensitive to positive reinforcement in the form of social attention (Hawkins et al., 1966).

No consequence/no interaction

All preferred stimuli were removed from the room or put out of reach and sight. There was no interaction between the experimenter and the participant and no programmed consequences were provided for any target behavior. The purpose of this condition was to identify whether the participant's target behavior persisted independent of social consequences in a relatively barren environment.

Play (control)

The experimenter provided attention to the participant in the form of praise, conversation, or physical touching (e.g., playful tickling) on a noncontingent, fixed time, 30-second schedule. There were no programmed consequences for a target behavior. Preferred stimuli were available continuously. The purpose of this condition was to serve as a control condition: the participant had access to preferred stimuli and noncontingent attention, and no instructions were presented (Iwata et al., 1982/1994).

Experimental Design

The experimental design and sequence of phases was based on Vollmer, et al., (1995) and Iwata, Duncan, Zarcone, Lerman, & Shore, (1994). Briefly, Vollmer et al., (1995) developed a method to determine the minimum length necessary to complete a clear, differentiated functional analysis. When assessing potentially dangerous behavior, it was important to keep the assessment brief as possible without sacrificing a clear demonstration of experimental control. A four-phase sequential assessment progressing from brief (1 to 2 hour) to extended analyses was utilized. Specifically, the four phases were: (a) brief multi-element format with within-session data analysis; (b) extended multi-element; and (c) pairwise test-control multi-element (Iwata et al., 1994). A brief description of the phases is presented in the remainder of this section. All data were evaluated using visual analysis of line graphs.

Figure 1 summarizes the model. For Phase 1, 2, and 3, four or five of the analog conditions were presented in either a brief, extended, or pairwise multi-element design. If the response patterns were undifferentiated (i.e., no clear, replicable pattern) by the end of the phase, the participant would progress to the next, more extensive assessment phase. If a clear, replicable response pattern emerged, the assessment was considered complete and the participant was not exposed to additional phases. If no instances of the target behavior were observed during Phase 2, nonexperimental assessment methods were administered and the experimental analysis was aborted.

Analog phase 1 "brief"

All participants were exposed to Phase 1. Analog conditions were presented in an alternating, brief fashion (7 to 9 sessions). Within-session response patterns were evaluated. That is, the frequency of aggression or percentage of intervals with tantrums within each minute of each session was depicted on a graph for the purpose of visual analysis (Vollmer, Iwata, Zarcone, Smith, & Mazaleski, 1993b). If results were differentiated, the assessment was considered complete, and the participant was not exposed to additional phases. If results were undifferentiated, the participant would progress to Phase 2. Determining whether response rates are differentiated across conditions is a subjective enterprise using visual analysis, but a general consensus was reached within our team of

researchers. Vollmer et al., (1995) outlined several explanations to account for undifferentiated results during a brief assessment including: (a) the participant may have difficulty discriminating between experimental conditions; (b) the target response was multiply controlled; (c) interaction and/or carryover effects; (d) the target behavior may be maintained independent of the social environment; and/or (e) no occurrences of the target behavior were observed during analog conditions.

Analog phase 2 "multi-element"

Phase 2 was designed to reduce problems discriminating between experimental conditions by exposing the participant to more repeated, alternating, analog conditions. Sessions conducted during Phase 1 were incorporated into the data analysis of Phase 2, but additional sessions were conducted. The design during Phase 2 was based on Iwata et al. (1982/1994) and differed from Phase 1 in the following ways: (a) the participant was exposed to more sessions; (b) each of the conditions was repeated three to seven times; and (b) data were analyzed using session means as opposed to minute-by-minute rates of aggression.

Analog phase 3 "pair-wise"

Phase 3 was designed to address possible interaction and/or carryover effects. Specially, each of the analog conditions was re-presented in isolation and alternated with

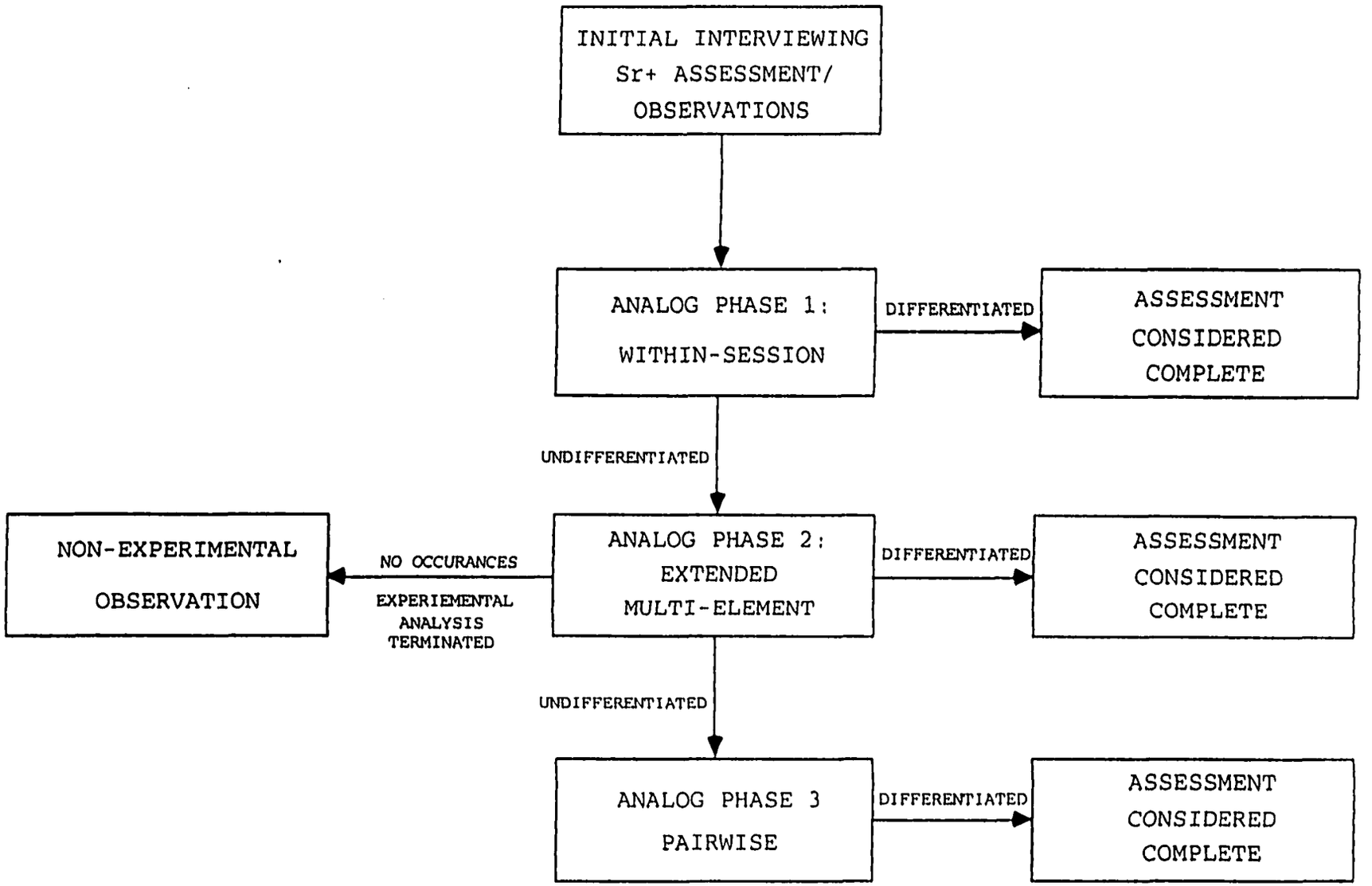

Figure 1: Assessment of Aggression: Flow Chart

play (control) conditions only (Iwata et al., 1994). As in Phase 2, mean response rates were plotted graphically for the purpose of visual analysis

Iwata et al., (1994) developed a pair-wise functional analysis methodology to reduce carryover effects, interaction effects, or both, which are sometimes associated with multi-element and reversal designs. Iwata et al., (1982/1994) proposed undifferentiated rates of SIB may be due interaction effects. That is, one experimental condition may interfere with subsequent conditions (e.g., same therapist conducting different analog conditions). By contrasting the test condition with the control only, the distinction between contingencies in effect is made highly salient.

Nonexperimental Observation

This phase was designed for one participant when no occurrences of the aggression were observed during analog conditions (Marty only). An extensive interview was conducted with the referring teacher and parent. Information obtained during the interview was incorporated into a series of naturalistic observations. During the interview, hypothesized high incident times, activities, and other persons correlated the aggression were identified. During naturalistic observations, rates of aggression and consequences following an instance of aggressive behavior were coded. The probability of various events (e.g., attention) following aggression was calculated and compared

to the probability of those events occurring independent of aggressive behavior.

During this study, assessments were considered complete after: (a) Phase 1 (four participants); (b) Phase 2 (six participants); (c) Phase 3 (one participant); and (d) Nonexperimental observation (one participant).

RESULTS

Figure 2 displays the results for four of the participants' brief functional analyses. Data for each session are plotted as minute-by-minute frequencies. For each of the four participants, clear response patterns were obtained within ten or fewer sessions. The upper panel shows Sammy's assessment, in which tantrums were observed exclusively during the tangible positive reinforcement sessions (range, 0% to 50% of the intervals). Response patterns were replicated by conducting two positive reinforcement sessions. The results show a clear behavioral sensitivity to tangible positive reinforcement.

The second panel shows the results of Joel's assessment in which high rates of aggressive behaviors were observed almost exclusively during the negative reinforcement conditions, averaging 2.8 responses per minute (range, 0 to 14). Joel did not exhibit aggressive behaviors during any of the other conditions with the exception of 1-minute during a play condition (1.0 response per minute). Additionally, aggressive behavior in response to negative reinforcement conditions was replicated within and across three sessions. The results show a clear behavioral sensitivity to negative reinforcement.

The third panel shows Matt's assessment in which aggression was observed almost exclusively during the negative reinforcement condition (range, 0% to 83.3%). Matt did not exhibit aggressive behaviors during any of

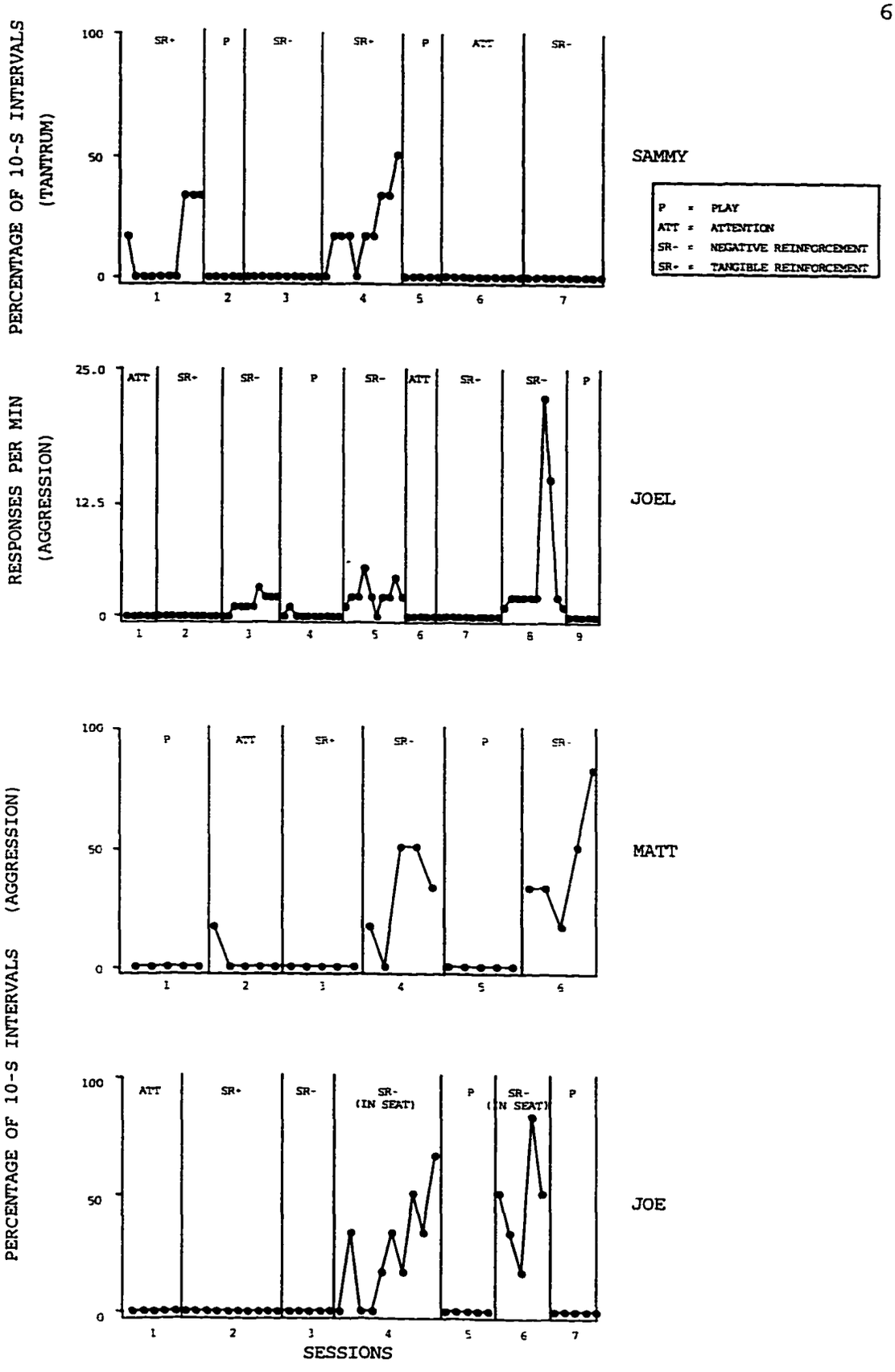

Figure 2: Brief Assessment: Within-Session Functional Analysis

the other conditions with the exception of 1-interval during an attention condition (17% of the intervals during the first minute). Additionally, aggressive behavior in response to negative reinforcement conditions was replicated within and across two sessions. The results show a clear behavioral sensitivity to negative reinforcement.

The lower panel shows Joe's assessment in which tantrums were observed exclusively during the negative reinforcement in-seat condition (range, 0% to 88.9%). Joe did not exhibit tantrum behaviors during any of the other conditions including a negative reinforcement condition in which he was not required to remain seated. Additionally, aggressive behavior in response to negative reinforcement, in-seat conditions, was replicated within and across two sessions. The results show a clear behavioral sensitivity to negative reinforcement.

For each of the other eight participants, the brief assessment phase was inconclusive (not depicted here). Figure 3 displays the results for four participants whose assessments are depicted using a multi-element format, because the results of the within-session analysis were undifferentiated. For each of the participants, results showed a sensitivity to positive reinforcement in the form of access to tangible items. The upper left panel shows the results of Seth's assessment in which rates of aggression were highest during the tangible positive reinforcement conditions, averaging 5.6 responses per minute (range, 3.4

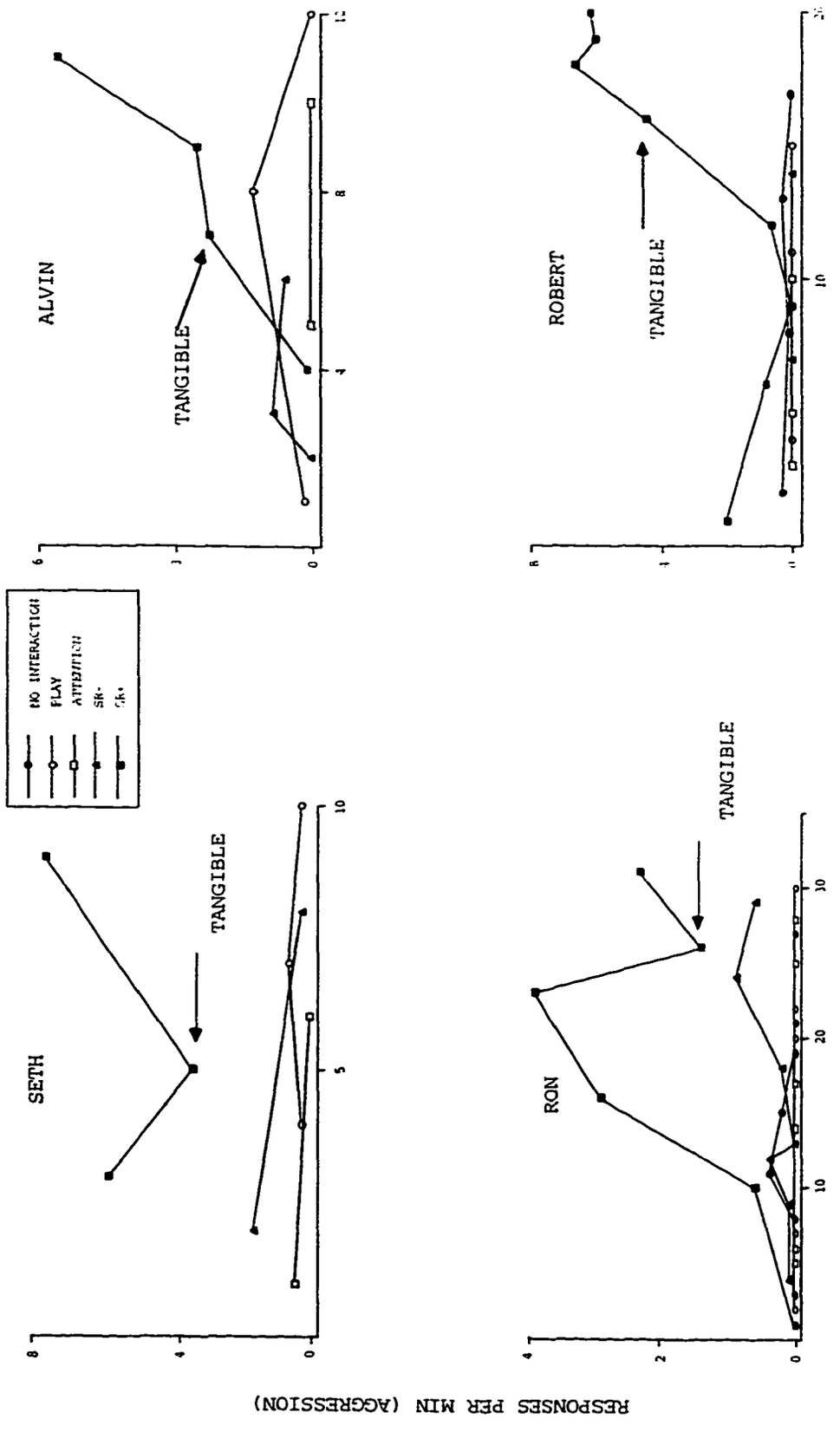

Figure 3: Multi-element Assessment: Tangible Positive Reinforcement

to 7.6)[.2 responses per minute during the attention conditions (range, 0 to .4); .9 responses per minute during the negative reinforcement conditions (range .2 to 1.6); and .3 response per minute during the play conditions (range, .2 to .6)].

The upper right panel in Figure 3 shows the results of Alvin's assessment. Rates of aggression were highest during the tangible positive reinforcement conditions, averaging 2.7 responses per minute (range, .1 to 5.6). Alvin engaged in lower rates of aggression during the negative reinforcement (averaging, .5 response per minute; range 0 to .9) and play (averaging, .5; range 0 to 1.3) conditions. No aggression was observed during the attention conditions.

The lower left panel depicts Ron's assessment. Aggression rates were highest during the tangible positive reinforcement conditions, averaging 2.5 responses per minute (range, 1.4 to 3.9) as compared to all other conditions. No aggression was seen in other conditions with the exception of the beginning of two negative reinforcement sessions (range, 0 to 4 responses per minute).

The lower right panel displays Robert's assessment in which rates of aggression were highest during the tangible positive reinforcement conditions, averaging 3.5 responses per minute (range 0 to 6.7) as compared to all other conditions. Robert engaged in no aggression during play, attention, and negative reinforcement conditions and an

average of .1 responses per minute during alone conditions (range 0 to .3).

Figure 4 depicts the results for two of the participants whose results indicated a behavioral sensitivity to negative reinforcement during the multi-element assessment. The upper panel displays the results of Rick's assessment in which high rates of aggressive behaviors were observed during the negative reinforcement (in-seat) condition and lower rates of aggressive behaviors were observed during the negative reinforcement condition in which he was not required to remain seated. Specifically, Rick engaged in an average of .3 responses per minute (range, 0 to .6) during negative reinforcement in-seat conditions and .05 responses per minute during the negative reinforcement out-of-seat conditions (range 0 to .1). Further, he engaged in no episodes of aggressive behavior during tangible, attention and play conditions. He displayed an average of .1 responses per minute during no interaction conditions (range 0 to .2).

The lower panel displays the results for Kyle. High rates of aggressive behavior were observed during the negative reinforcement condition and in the second tangible reinforcement session. During the negative reinforcement condition, Kyle engaged in an average of 1.1 responses per minute (range, .7 to 1.2) and averaged .4 responses per minute during tangible conditions (range, 0 to .7). Due to the end of the school year, the assessment was abbreviated

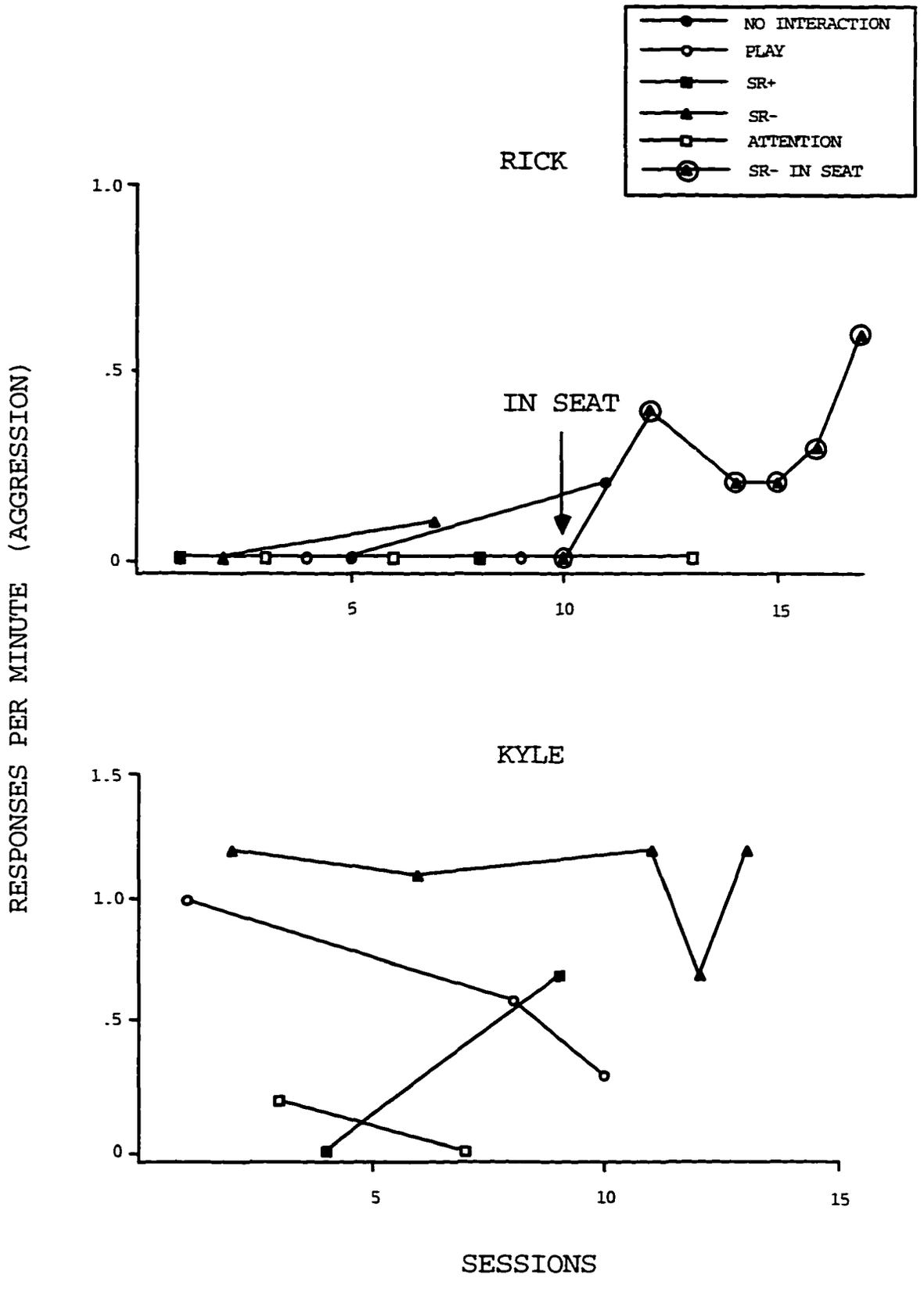

Figure 4: Multi-element Assessment: Negative Reinforcement

before reaching conclusions about the tangible positive reinforcement condition. Kyle engaged in relatively lower rates of aggression during play (averaging .6; range .3 to 1.0) and attention conditions (averaging .1; range 0 to .2).

For the remaining two participants, results of the brief and extended multi-element analyses were inconclusive. For Emily, aggressive rates were undifferentiated across conditions. For Marty, no aggression was observed.

Figure 5 shows the results of Emily's assessment. The upper panel depicts the multi-element analysis, which was undifferentiated. Emily engaged in some aggressive behaviors during all conditions with the exception of play. During no consequence Emily engaged in 1.6 responses per minute (range .3 to 3.6); .4 responses per minute during the tangible positive reinforcement conditions (range, .1 to .7); .5 responses per minute during the negative reinforcement conditions (range 0 to .8); and .3 responses per minute during the attention conditions (range, .1 to .5). Thus, it appeared there may have been interaction effects during the assessment. To minimize interaction effects, a pair-wise assessment was conducted (Iwata et al., 1994). The lower panel displays the results of the pair-wise assessment (Phase 3). During this assessment, each of the assessment conditions was compared to the play (control) condition. The results suggest a clear behavioral sensitivity to tangible positive reinforcement. Emily engaged in an average of .3 response per minute (range 0 to

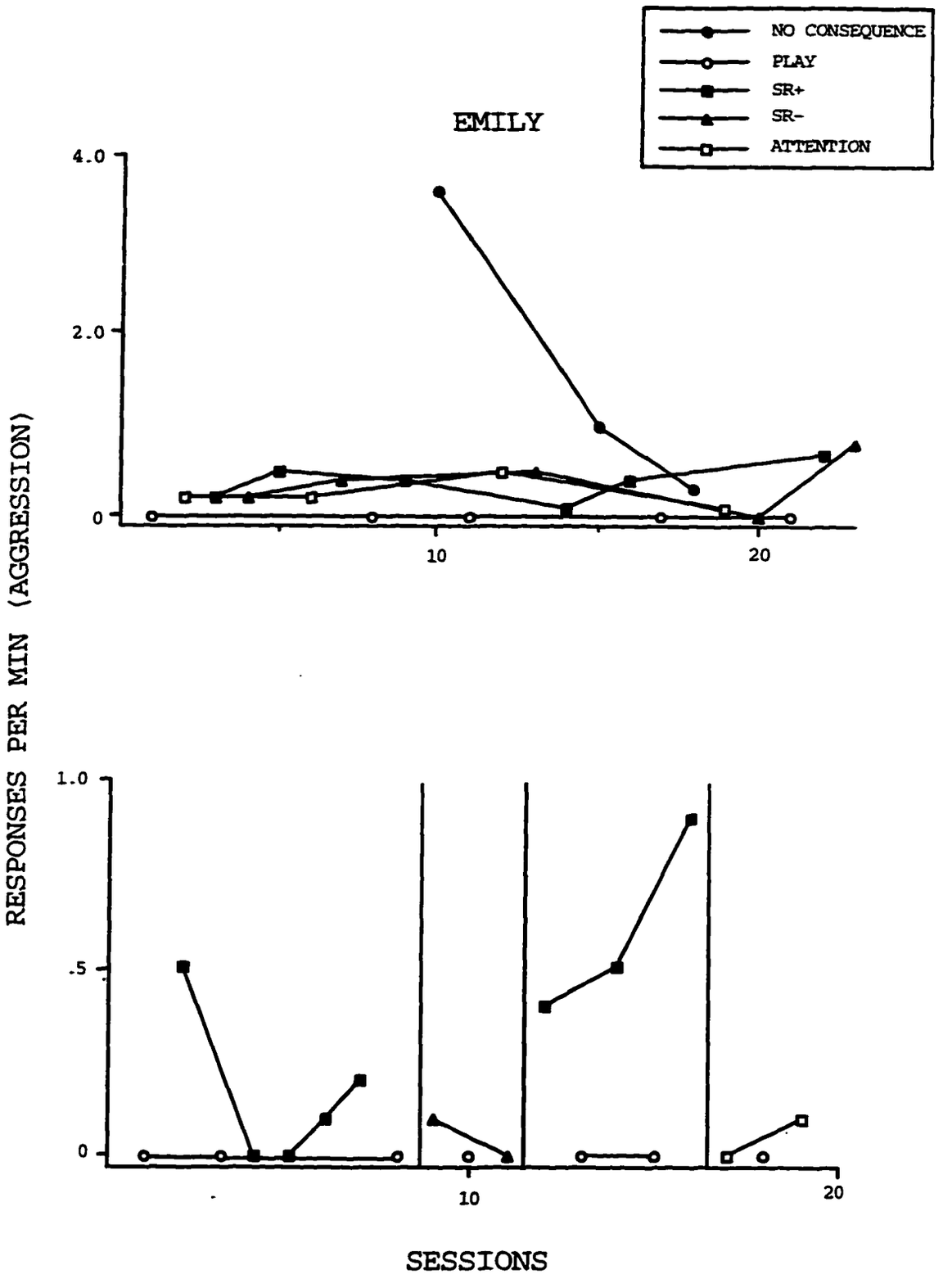

Figure 5: Pair-wise Assessment

.9) during the tangible positive reinforcement conditions; she engaged in an average of .05 responses per minute (range, 0 to .1) during the negative reinforcement and attention conditions; she engaged in no aggression during play conditions.

Figure 6 shows the results of Marty's assessment. During the functional analysis (upper panel), no aggressive behavior was observed during any of the conditions (negative reinforcement, play, tangible, attention). An extensive interview was conducted with Marty's classroom teacher and with his mother who reported that high rates of aggression occurred in the classroom setting or when around other children in general. However, she reported all of the aggression was directed towards peers in the environment as opposed to adults. Thus, an experimental analysis with only an adult would be unlikely to produce aggressive responding.

The lower panel depicts the results of a (nonexperimental) descriptive assessment that took place in Marty's classroom over a 3.5 hour period across 6 days. During the observations, Marty was engaged in typical classroom activities such as recess, circle time, free play, and story time. The probability of specific events (teacher attention, peer attention, escape, access to tangible items) occurring during any 10-second partial interval was compared to the conditional probability of those events given an instance of aggression. The results of the descriptive analysis indicated there was some baseline level of

teacher/peer attention, access to tangible items and escape from instruction provided to Marty. However, the probability of peer attention increased, notably following instances of aggression. Thus, Marty's aggression may have been maintained, in part, by positive reinforcement in the form of peer attention. A contingency existed between aggression and peer attention (Hammond, 1980), but whether that relation represented a reinforcement contingency was untestable for ethical reasons.

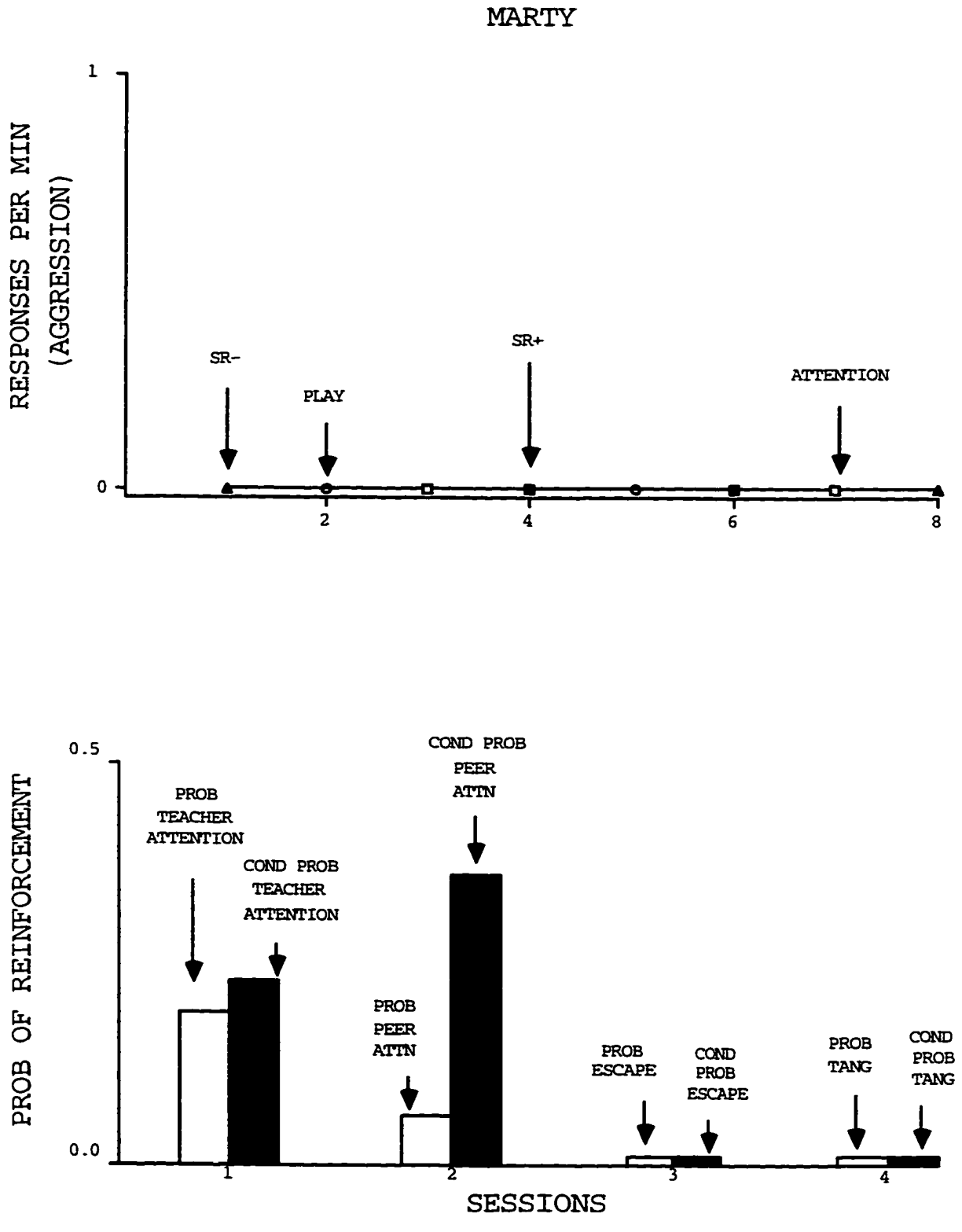

Figure 6: Descriptive Assessment

GENERAL DISCUSSION

This study can be viewed as a systematic replication of the Iwata et al., (1982/1994) study using aggression as the target behavior. Results suggest aggressive behavior is, at times, sensitive to contingencies of reinforcement. The functional analyses identified operant mechanisms for 11 of the 12 participants. Specifically, 6 of the 12 participants' aggressive behavior was differentially responsive to tangible positive reinforcement; and 5 of the 12 participants' aggressive behavior was differentially responsive to escape as negative reinforcement.

The results of this study were consistent with hypotheses presented by earlier researchers. For example, Hawkins et al., (1966) hypothesized aggression may be sensitive to maternal attention. Likewise, Patterson (1967) hypothesized aggression could be sensitive to positive reinforcement in the form of access to adult attention or peer attention, and access to tangible items. Similarly, Carr (1980) suggested aggression may be sensitive to negative reinforcement. Wacker (1990) and Northup (1991) demonstrated via a functional analysis, with a limited number of participants, that aggression can be multiply controlled. Thus, this study supports an operant interpretation of aggressive behavior displayed by children with developmental disabilities.

A significant number of individuals are referred for assessment and treatment of severe aggressive behavior.

High rates and/or high intensity aggressive behavior, left untreated, may result in the removal of an individual from academic, vocational, residential, and/or social settings. The extent to which health care providers understand the underlying maintaining variables of aggression may determine the extent to which aggressive behavior can be accurately assessed, treated, or both. For example, if assessment data indicate that an individual's aggressive behavior is sensitive to tangible positive reinforcement, access to tangible items could be presented contingent on an alternative response (e.g., saying "please") and withheld contingent on instances of aggression. Although not presented in this study, 8 of the 12 participants' aggressive behavior were subsequently treated by developing interventions that attempted to extinguish the relationship between aggressive behavior and social/tangible positive reinforcement or negative reinforcement. For example, for several of the participants in this study, differential reinforcement was provided contingent on an alternative response such as compliance and/or communication

Aside from the potential clinical utility of conducting functional analyses of aggression, the results of this study provide basic scientific information about the underlying mechanisms of aggression. Although there are several hypotheses (e.g., catharsis, biological predisposition, operant) offering explanation of the etiology of and maintaining variables for aggressive behavior, few empirical

studies have actually been conducted. This study provides empirical evidence supporting the operant models of aggression.

This study also replicated the functional analysis decision making model outlined by Vollmer et al., (1995). Vollmer et al., (1995) developed a method to determine the minimum length necessary to complete a clear, differentiated functional analysis. The results indicated reinforcement contingencies for 6 of the 20 participant's aberrant behavior was identified during a 'brief' assessment; 4 of the 20 participant's aberrant behavior was identified during a 'multi-element' assessment; 5 of the 20 participant's aberrant behavior was identified during a 'no interaction' assessment; 2 of the 20 participant's aberrant behavior was identified during a 'reversal' assessment; and 3 of the 20 participant's aberrant behavior was not identified using functional analysis procedures. In this study, reinforcement contingencies for 4 of the 12 participants' aggressive behavior was identified during a 'brief multi-element' (total, 30 minute to 1 hour) assessment; 6 of the 12 participant's aggressive behavior was identified during an 'extended multi-element' (total, 1.5 to 3 hours) assessment; 1 of the 12 participant's aggressive behavior was identified during an extended 'pair-wise' assessment (total, 4 hours); and 1 of the 12 participants behavioral function was not identified using functional analysis procedures (Marty). Therefore, in comparison, Vollmer et

al., (1995) identified a clear operant function for 17 of the 20 participant's aberrant behavior (i.e., 85%). Similarly, in this study, clear operant function was identified for 11 of the 12 participant's aggressive behavior (i.e., 92%).

Although the results of this study are promising, there are several limitations suggesting avenues for future research. First, only 12 children participated. General conclusions related to the etiology and maintaining variables of aggressive behavior cannot be made. Therefore, future researchers will need to replicate the methodology presented in this study with a larger sample of participants exhibiting aggressive behavior.

Second, it may be difficult to produce the aggressive behavior of some individuals during an analog assessment. In this study, we were unable to produce aggressive behavior during the analog assessment for one participant. There are several variables that may account for low rate aggression during an analog assessment including: (a) although referred due to aggression severity, some individuals may simply display low rate high intensity behavior (e.g., severe aggression that occurs once per month); (b) the researcher or clinician may not correctly identify or reproduce the specific maintaining contingencies within the analog assessment (e.g., aggressive behavior sensitive to consequences delivered by peer/siblings); (c) participants may have difficulty discriminating between the contingencies

in place during each of the conditions; (d) the novelty of the therapist, setting, or environmental cues; (e) difficulty replicating a 'no interaction' condition. To clarify, during the 'no interaction' condition, the therapist remains in the therapy room and in close proximity to the participant. There are no programmed consequences for aggression during this condition. That is, the therapist would theoretically not respond to aggressive behavior. However, it is unlikely that even the most experienced therapist could entirely "ignore" severe aggression. Most likely, the therapist would produce a startle response, wince, exhibit physical pain, and/or attempt to block the aggression. It is possible that even minimal social responding may be sufficient to maintain socially mediated aggression; and (f) the aggression may be elicited as opposed to emitted.

For one participant in this study (Marty), aggression was reported to be a response exclusively directed towards peers in the environment. Due to obvious ethical considerations, peers could not participate in analog conditions. There is a need to continue to refine functional assessment procedures to enable professionals to directly assess aggressive responding within the natural environment.

There are possible methodological limitations of analog assessments. For example, it is possible repeated exposure to the contingency (aggression resulting in access to potential reinforcers), frequent withdrawal of preferred

items, or both may superficially inflate rates of aggression. That is, the participant may exhibit significantly higher rates of aggressive behavior during the analog assessment than rates observed in the natural environment. Further, aggressive behavior may be shaped during the actual assessment. However, two variables are worth noting. First, the individuals who participated in this study were being referred for an assessment of aggressive behavior. That is, aggressive behavior was already being displayed in the natural environment. Therefore, there is no question that aggressive behavior pre-existed the functional analysis. Further, during initial interviews, the participant's care-providers were reporting aggressive behavior observed during situations similar to the analog conditions (e.g., following removal of a toy or an instruction). Secondly, although rates of aggressive behavior may have been increased during the actual assessment, the investigators were evaluating relative rather than absolute magnitude or rate of the aggressive behavior. The purpose of this study was to evaluate potential maintaining variables of aggressive behavior.

For the 12 children who participated in this study, automatic reinforcement was not identified as a maintaining contingency. However, it is possible that some instances of aggressive behavior may be maintained independent of the social environment. Due to the topography of aggression

(attacking/harming others), it was impossible for even the experienced therapists in this study to provide no response tc aggressive behavior during the no interaction conditions. To completely assess for automatic reinforcement, the therapist would have to be repetitively assaulted without changing facial expression, wincing, shuddering, clenching muscles or attempting to block the aggressive behavior delivered by the participant. Although responses produced by the therapist may be minimal, it is possible that even slight response could socially maintain aggressive behavior. One possible alternative for assessing whether an individuals aggressive responding is sensitive to automatic reinforcement would be to develop a prosthetic device that visually and tactily replicates a human form. An artificial device could potentially provide reinforcement (simulating bleeding, movement of skin-like tissue) without presenting accidental social reinforcement.

To conclude, this study presents a methodology for evaluating potential operant mechanisms maintaining aggression. If functional analysis methodology can be used to reliably identify such mechanisms, treatment procedures can be systematically selected and severely dangerous forms of behavior can be better understood.

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VITA

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Title of Dissertation: Experimental Analysis of Aggression

Approved:

Major Professor and Chairman

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EXAMINING COMMITTEE:

Date of Examination:

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